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Chemical Composition of Green and Variegated Leaves Of Some Ornamental Plants

Sayyed I.U.
Department of Botany
AKIS Poona College of Arts, Science and commerce, Camp. Pune-411001
Email: Sayyed_iliyas@yahoo.com

ABSTRACT

Variegation (patchy surface area with different colours) is a common trait of plant leaves. In green-white variegated leaves, two tissues with contrasted primary carbon metabolisms (autotrophic in green and heterotrophic in white tissues) are juxtaposed. It is generally believed that variegation is detrimental to growth due to the lower photosynthetic surface area. However, the common occurrence of leaf variegation in nature raises the question of a possible advantage under certain circumstances. During present study the chemical changes of green and variegated leaves of some plants were observed. Results showed variation in moisture, % Dry matter, total ash, acid soluble ash, acid insoluble ash, nitrate reductase activity, metal ions like phosphorous and calcium. The nitrate reductase activity was decreased in variegated parts of all the plant species.

Keywords: *Nitrate reductase, variegated plants, variegated patches, ornamental plants.*

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INTRODUCTION

Most Angiosperms families have species or varieties with variegated leaves, that is, patchy leaves with green and nongreen (sometimes white) areas. Variegated species are often found amongst under storey herbs in temperate and tropical Evenari [5], but also include crops such as alfalfa (*Medicago sativa* L.), sugar beet (*Beta vulgaris* L.), and parsnip (*Pastinaca sativa* L.) [11]. The fact that variegation occurs in nature raises the question of the possible mechanisms (selective advantage) that maintains such a leaf trait. Amongst possible advantages are [13]: (i), leaf variegation may mimic leaf miners damage and thus dissuade female miners to deposit eggs; (ii), white areas have a larger reflectance and may thus decrease leaf temperature; (iii), leaf variegation may play the role of an aposomatic coloration. Alternatively, Givnish [6] has proposed that leaf variegation serves to camouflage the foliage to colour-blind herbivores. The latter hypothesis would agree with the cost in nitrogen of leaf damage, since forest herbs have relatively high elemental N content and furthermore, white areas of green-white variegated leaves are particularly N-rich. However, there is presently little evidence in favour of any of these hypotheses, except, maybe, for data from field experiments on *Byttneria aculeata* Jacq. (Malvaceae) that showed a lower prevalence of miner attack in variegated than plain morph, for any given frequency of the variegated morph [13]. Nevertheless, possible ecological advantages of leaf variegation cannot be divorced from metabolic imperatives. On the one hand, the absence of photosynthesis or the prevalence of respiration in white (chlorophyll-deprived) areas is detrimental to the plant carbon balance [7] despite a generally lower respiration rate in white compared with green areas [15]. Indeed, biomass production is lower in variegated than plain (non-variegated) plants [4]; but see Vaughn and Stewart [16] for an opposite case in Hosta) and white areas strictly depend upon the sugar input from green areas [9, 10]. On the other hand, white areas have been shown to be N-rich (higher elemental N content), with considerable amounts in free amino acids (such as Arg, Asn and Lys) and polynitrogenous compounds (e.g. ornithine) [14, 12, 3]. In the variegated mutant immutans of Arabidopsis, white sectors exhibit a higher expression of genes associated with Asn synthesis (Asp-aminotransferase and Asn synthetase) [2]. It has been argued that white and green areas undergo metabolic exchanges, with green areas providing a carbon source to white areas that may, in turn, redistribute nitrogenous compounds [14] and thus, leaf variegation has been suggested to exemplify 'a kind of successful parasitism' between two leaf parts [5]. In a previous study, we showed that in variegated leaves of *Pelargonium hortorum* L.H.Bailey (Geraniaceae), white areas were N-rich, with a typical accumulation of Arg [14]. Metabolomic analyses further suggested the enhancement of alkaloid and Arg biosynthesis in white areas, and leaf-part specific isotopic labelling demonstrated that white and green areas of the same leaf exchanged nitrogenous molecules (with nitrogen export from green areas being quantitatively much more important). That is, 15N-nitrate deposited in the green area caused a clear 15N-enrichment in the white tissue, thereby suggesting that N was reduced in green areas (which have a nitrate reductase activity) and subsequently translocated and metabolised in white areas. However, the rationale of such a functional division of metabolism between white and green areas in variegated leaves remains unclear, and the possibility that nitrogen can be exported from white areas under certain circumstances cannot be excluded. That is, there might be some advantages of accumulating nitrogenous compounds in white areas: for example, under N-limited conditions, the remobilisation of nitrogenous compounds from white leaf parts could contribute to sustaining N-requirements for plant growth and development. To test the hypothesis experiments were conducted to observe the Nitrate reductase activity along with the chemical changes takes place in green and variegated parts of the leaves.

MATERIAL AND METHODS

The leaves of *Sansevieria cyllindrica*, *Codiaeum varietum, Acalypha wilkesiana, Chlorophytum comosum, Hibiscus rosa sinensis and Bougainvillea spectrabilis* used to study chemical changes takes place in green and variegated parts. Plantlets were generated from cuttings planted in peat for 2 weeks for rooting and then transferred to potting mix. Plants were then grown in the greenhouse under 22/18 C, 60/55% RH, 16/8 h photoperiod (day/night). Plants were automatically watered five times a day.

The moisture content was expressed as per cent loss in weight. Day matter (DM) content was determined by drying a sample to a constant weight at 65±5^{o}C. Total ash, acid soluble ash (ASA), Acid insoluble ash (AIA), Calcium (ca) and phosphorus(P) were estimated as described by A.O.A.C. [1]. Activity of nitrate reductase was determined following the in vivo method described by Jaworski [8].

RESULTS AND DISCUSSION

Nitrate reductase (NR) is one of the major enzymes of nitrogen metabolism which catalyses the primary step of nitrogen assimilation in higher plants. The inhibition of this enzyme would not only affect nitrate reduction but disturb the overall the nitrogen metabolism in the leaves. The result obtained in present experiment showed in table no. 1. Moisture in the green part of the leaf (74.06) is less as compared to variegated part of the leaf (76.04). Same case with the dry matter (DM) content from 25.86% to 23.92% respectively. Total ash contents is increased from green to variegated parts i.e.17.33% to 19.80%. Acid soluble ash (ASA) also showed decrease results from green to variegated parts i.e.07.43 to 6.43% wherein there in increase in acid insoluble ash (AIA) content from green to variegated parts i.e. 10.00 to 11.65%. The enzyme nitrate reductase (NR) activity is decrease in variegated parts as compared to green parts of the leaves i.e. 297.65 to 110.89 µmoleNo_2 $h^{-1}g^{-1}$. The increase in phosphorous (P) content in variegated part as compared to green part of the leaves i.e. 10.88 to 16.87%. Calcium (Ca) content is decreased from green to variegated part of the leaves i.e. 20.90 to 17.00%. The results obtained in present investigation clearly showed the increase in moisture, total ash, acid insoluble ash, and phosphorous while decrease in % dry matter (DM), Acid soluble ash, enzyme nitrate reductase activity and calcium content from green to variegated parts.

CONCLUSION

Leaf variegation is a common feature resulting from the uneven distribution or deficit of photopigments. Variegated leaves are economically important in horticulture and used as ornamental plants and are scientifically significant for plant research. In natural environments, the occurrence of variegation hypothetically enables plants to either adapt to changing light conditions or reduce the nitrate acivity. Variegation might also be a form of mimicry to prevent infestation by insects. Research associated with chemical changes from green to variegation has characterized structural, functional, and molecular differences between green and non-green sectors. White sectors also lack photosynthetic activity and show inactivation of fluorescent kinetics and electron transport. Reduced nitrate activity plays very active role to produce variegated plants or ornamental plants.

Table No:1 Chemical composition of green and variegated leaves of some ornamental plants

Name of the plants		*Sansevieria cyllindrica*	*Codiaeum varietum*	*Acalypha wilkesiana*	*Chlorophytum comosum*	*Hibiscus rosa sinensis*	*Bougainvillea spectrabilis*	Mean	S.D.	C.V.
Moisture	G	86.89	79.52	76.79	77.89	78.26	45.02	74.06	14.68	10.87
	V	88.79	81.16	78.57	79.38	79.84	48.50	76.04	13.99	10.64
% DM	G	13.10	20.47	23.20	22.10	21.30	54.97	25.86	14.71	3.80
	V	11.02	18.83	21.42	20.61	20.15	51.50	23.92	14.03	3.36
Total ash (%)	G	16.6	10.9	21.9	16.2	18.4	20.0	17.33	3.80	0.66
	V	19.3	14.4	22.2	20.6	20.4	21.9	19.80	2.85	0.56
ASA %	G	11.6	02.5	07.0	03.0	11.4	09.1	07.43	4.00	0.30
	V	08.3	00.1	05.3	01.9	15.1	07.9	6.43	5.34	0.34
AIA (%)	G	05.0	08.4	15.5	13.2	07.0	10.9	10.00	3.95	0.39
	V	11.0	14.3	16.6	18.7	05.3	04.0	11.65	6.01	0.70
Δ OD $h^{-1}g^{-1}$	G	0.18	0.49	4.17	2.03	0.25	21.36	4.75	8.28	0.39
	V	0.13	0.31	2.12	0.16	0.07	7.37	1.69	2.89	0.05
µmoleNo_2 $h^{-1}g^{-1}$	G	11.2871	30.7260	261.4851	127.2937	15.6765	1339.4059	297.65	519.30	1545.66
	V	8.1518	19.4389	133.5643	37.6237	4.3894	462.1452	110.89	178.62	198.06
Phosphorus (%)	G	10.7	14.5	21.5	7.9	9.1	1.6	10.88	6.69	0.73
	V	18.9	17.1	31.1	11.0	13.7	9.4	16.87	7.84	1.32
Calcium (%)	G	23.2	8.5	31.0	3.9	7.3	51.5	20.90	18.28	3.82
	V	7.0	11.5	31.0	4.2	5.3	43	17.00	16.14	2.74

G: Green, V:Variegated

REFERENCES

1. A.O.A.C. (1970) Official and Tentative Methods of Analysis'. Association of official Agricultural Chemists, Inc. Washington, D.C.
2. Aluru MR, Zola J, Foudree A, Rodermel SR (2009) Chloroplast photooxidation-induced transcriptome reprogramming in Arabidopsis immutans white leaf sectors. Plant Physiology 150, 904–923.
3. DeKock PC, Morrison RI (1958) The metabolism of chlorotic leaves. 1. Amino acids. Bioch 70, 266–272.
4. Downton WJS, Grant WJR (1994) Photosynthetic and growth responses of variegated ornamental species to elevated CO2. Australian Journal of Plant Physiology 21, 273–279.

5. Evenari M (1989) The history of research on white-green variegated plants. Botanical Review 55, 106–139.
6. Givnish TJ (1990) Leaf mottling: relation to growth form and leaf phenology and possible role as camouflage. Functional Ecology 4, 463–474.
7. Ivanova TI, Sherstneva OA (1999) Dark respiration of variegated leaves in plants of different life forms. Russian Journal of Plant Physiology: a Comprehensive Russian Journal on Modern Phytophysiology 46, 666–673.
8. Jaworski, E. G. (1971), Nitrate reductase assay in intact plant tissues. Biochem. Biophys. Res. Communi., 43, 1274-1279
9. Jones H, Eagles JE (1962) Translocation of 14C-carbon within and between leaves. Annals of Botany 26, 505–510.
10. Madore MA (1990) Carbohydrate metabolism in photosynthetic and nonphotosynthetic tissues of variegated leaves of Coleus blumei Benth. Plant Physiology 93, 617–622.
11. Pringsheim EG, Schwarz W (1933) Das Auftretenweissbunter(panaschierter) Pflanzen in der Natur. Flora 28, 111–122.
12. Seltmann H (1955) Comparative physiology of green and albino corn seedlings. Plant Physiology 30, 258–263.
13. Smith AP (1986) Ecology of a leaf color polymorphism in a tropical forest species: habitat segregation and herbivory. Oecologia 69, 283–287.
14. Tcherkez G, Guérard F, Gilard F, Lamothe M, Mauve C, Gout E, Bligny R (2012) Metabolomic characterization of the functional division of nitrogen metabolism in variegated leaves. Functional Plant Biology 39, 959–967.
15. Toshoji H, Katsumata T, Takusagawa M, Yusa Y, Sakai A (2012) Effects of chloroplast dysfunction on mitochondria: white sectors in variegated leaves have higher mitochondrial DNA levels and lower dark respiration ratesthan green sectors.Protoplasma249, 805–817.
16. Vaughn KC, Stewart KD (1978) Light-harvesting pigment-protein complex deficiency in Hosta (Liliaceae). Planta 143, 275–278. doi:10.1007/ BF00391998 Witte CP (2011) Urea metabolism in plants. Plant Science 180, 431–438.

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